



# **The 101st Australian VLab Centre of Excellence Regional Focus Group meeting 28<sup>th</sup> June 2022**

**The Future of the VLab: what will the 200th  
Australian VLab CoE Regional Focus Group meeting,  
scheduled for 2031 be like**

**Bodo Zeschke Australian VLab Centre of Excellence Point of Contact**

# **The Future of the VLab: what will the 200th Australian VLab CoE Regional Focus Group meeting, tentatively scheduled for January 2031, be like?**

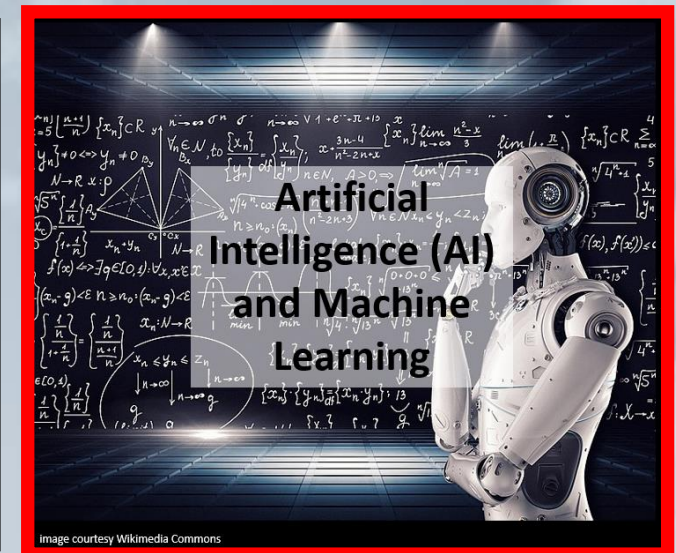
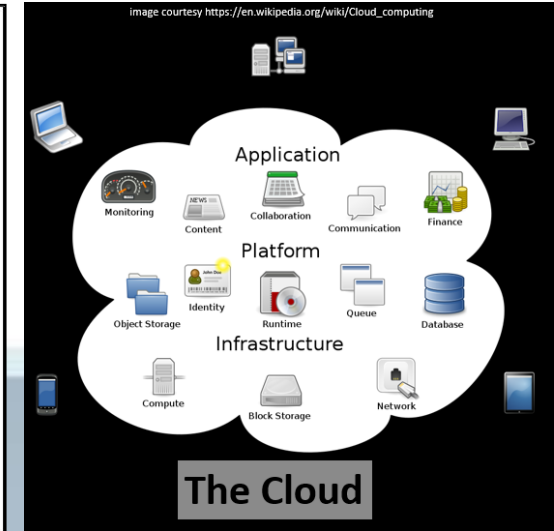
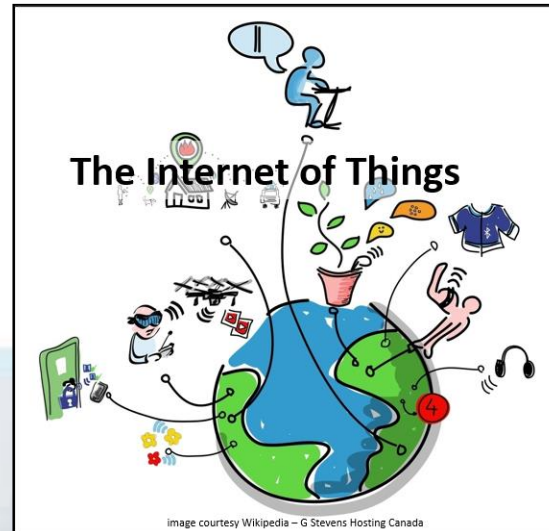
## **Contents**

- Constructing a "time capsule" for the year 2031
- Important developments likely to impact Satellite Meteorology teaching in 2031
- How might the 2031 Regional Focus Group (RFG) meeting be prepared and presented?
- What topics might be presented at this RFG meeting?

**...some slides not shown...**



# Important developments likely to impact Satellite Meteorology teaching and the VLab between now and 2031



**...some slides not shown...**



**AI makes big data analytics simpler by automating and enhancing data preparation, data visualization, predictive modelling, and other complex analytical tasks that would otherwise be labour-intensive and time-consuming.**

AI for Weather and Environment Satellite Remote Sensing Exploitation

Allen Huang  
Space Science & Engineering Center (SSEC)  
University of Wisconsin-Madison  
AOMSUC-10  
Melbourne, Australia  
Dec 4-6, 2019



# Artificial Intelligence (AI) and Machine Learning

**Dr Allen Huang presented CSPP-AI during AOMSUC-10**

<http://www.bom.gov.au/research/aomsuc-10/presentations/S4-P5-HUANG.pdf>

**In 2030, adaptive learning software will replace direct instruction.**

**Adaptive learning software is computer software that uses AI to move students up and down through a grade level's content based on student performance on assessment questions.**

<https://www.linkedin.com/pulse/heres-what-school-could-look-like-2030-mike-yates>

AI makes big data analytics simpler by automating and enhancing data preparation, data visualization, predictive modelling, and other complex analytical tasks that would otherwise be labour-intensive and time-consuming.

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**NOAA JPSS (Joint Polar Satellite System)  
The Community Satellite Processing Package (CSPP)  
supports the Direct Broadcast (DB) meteorological and  
environmental satellite community through the packaging  
and distribution of open source science software. CSPP  
supports DB users of both polar orbiting and  
geostationary satellite data processing and regional real-  
time applications through distribution of free open source  
software, and through training in local product  
applications.**

In 2030, adaptive learning software will replace direct instruction.  
Adaptive learning software is computer software that uses AI to move  
students up and down through a grade level's content based on student  
performance on assessment questions.

<https://www.linkedin.com/pulse/heres-what-school-could-look-like-2030-mike-yat>

image courtesy Wikimedia Commons

**REFERENCE**

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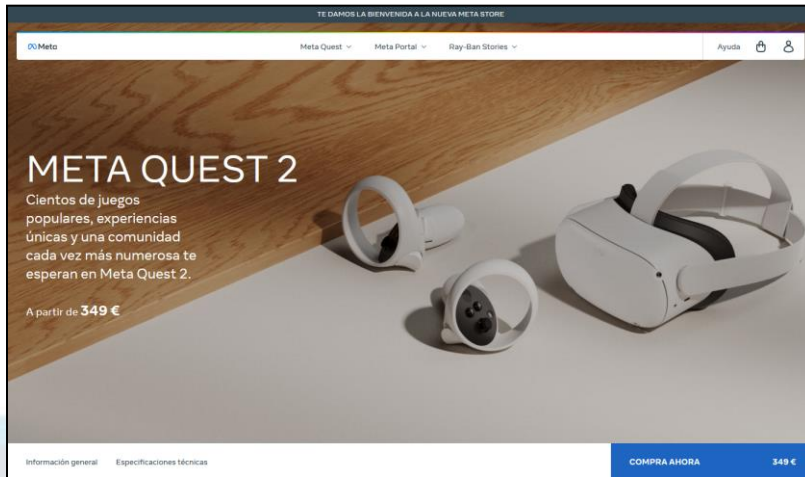
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- Constructing a "time capsule" for the year 2031
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- **How might the 2031 Regional Focus Group (RFG) meeting be prepared and presented?**
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**...some slides not shown...**



# The visualisation of the RFG meeting



Virtual Reality



Holography

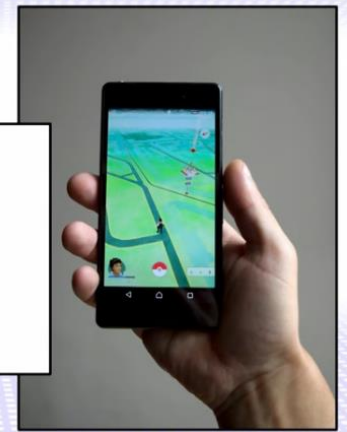
<https://news.mit.edu/2021/3d-holograms-vr-0310>



Light Field Displays

<https://www.holoxica.com/light-field-displays>

Augmented Reality



Augmented Reality

<https://www.youtube.com/watch?v=d-HRgfJbPvk>

# Explanation slide: the visualisation of the RFG meeting (1)

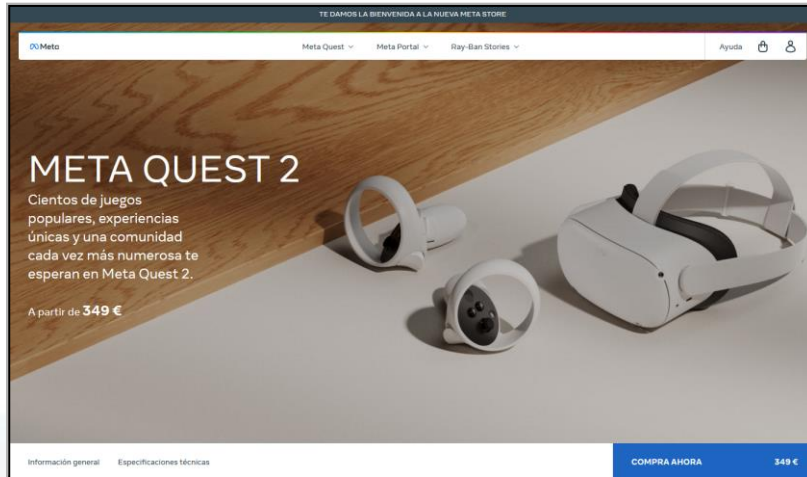
- Virtual Reality: images and sounds created by a computer that seem almost real to the user, who can interact with them by using sensors Oxford Dictionary <https://www.oxfordlearnersdictionaries.com/>
- "Despite years of hype, virtual reality headsets have yet to topple TV or computer screens as the go-to devices for video viewing. One reason: VR can make users feel sick. Nausea and eye strain can result because VR creates an illusion of 3D viewing although the user is in fact staring at a fixed-distance 2D display. The solution for better 3D visualization could lie in a 60-year-old technology remade for the digital world: holograms" Daniel Ackerman MIT News Office. <https://news.mit.edu/2021/3d-holograms-vr-0310>
- From the experimental work in 3D stereo vision as conducted at the Bureau of Meteorology (BOM) and the Meteorology Training Centre (BMTc) it was found that a proportion of staff and students were not comfortable in viewing anaglyph imagery using anaglyph glasses. [http://www.virtuallab.bom.gov.au/index.php/download\\_file/view/1572/227/](http://www.virtuallab.bom.gov.au/index.php/download_file/view/1572/227/)

**REFERENCE**

# Explanation slide: the visualisation of the RFG meeting (2)

- Other ways of viewing imagery in 2031 include:
  - Using AI to generate 3D holograms in real time
  - Light field displays, projecting 4D images directly onto retina.
  - Augmented Reality a technology that combines computer-generated images on a screen with the real object or scene that you are looking at. Oxford Dictionary <https://www.oxfordlearnersdictionaries.com/>
- This means that there may be varying degrees of "involvement" and "immersion" by participants in the VLab RFG meeting of 2031, depending upon the visualisation participants are comfortable with.
- Finally, there may be difficulty in translating traditional teaching material into VR. Some of the rules for designing traditional teaching material may not be applicable to VR teaching <https://www.youtube.com/watch?v=d-HRgfJbPvk>

# The visualisation of the RFG meeting



Virtual Reality



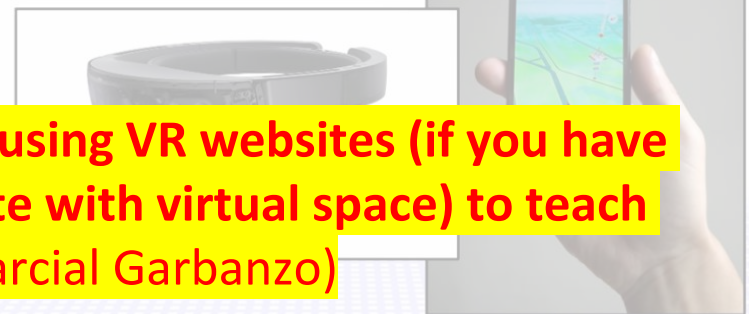
Light Field Displays

<https://www.holoxica.com/light-field-displays>

Some feedback about the use of VR from Marcial Garbanzo, TSO - WMO-CGMS Virtual Laboratory

"We are using the Quest 2 virtual reality set for some of the Meteorological Instruments course, and it helps quite a bit with understanding the Radar and Satellite data and products."

"Wen Bo mentioned yesterday that CMA is using VR websites (if you have not used VR it is hard to explain, but is a site with virtual space) to teach meteorologists in China" (Marcial Garbanzo)



Augmented Reality

<https://www.youtube.com/watch?v=d-HRgfJbPvk>

# Investigating the potential of 3D stereo satellite imagery utilising GEO-KOMPSAT-2A and Himawari-8 data.

(Regional Focus Group meetings January, February, October 2019, March 2021).

## Motivation: utilisation of Himawari-8 and GEO-KOMPSAT-2A data in combination

Image from KARI



GEO-KOMPSAT-2A located at 128.2E

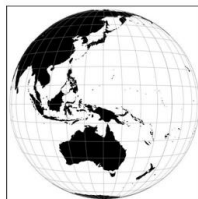
Image from JMA



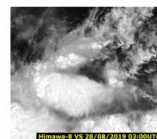
Himawari-8 located at 140.7E,



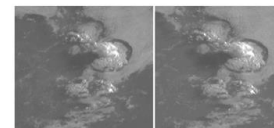
Separation of  
12.5 degrees



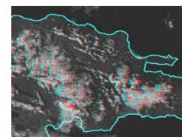
## Various ways of presenting 3D stereo satellite imagery



1: "3D Wiggle"  
animation



2: Stereo pair images  
(cross eyed viewing method)



Anaglyph glasses



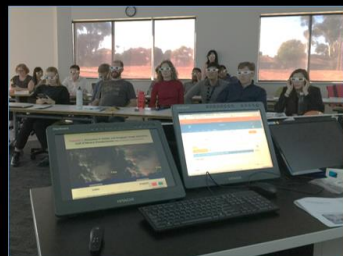
3: "Anaglyph" animation  
(requiring viewing glasses)



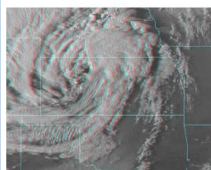
4: 2 panel image animation  
played on Smartphone  
and rendered in a viewer  
(eg. Google Cardboard).



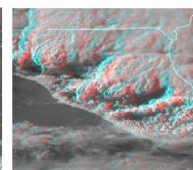
Testing 3D  
stereo  
satellite  
imagery in the  
classroom with Dr  
Hyesook Park  
(2019)



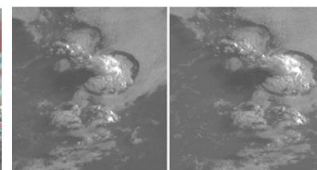
## Advantages in using 3D stereo satellite imagery



Analysing multilayer  
cloud, superior AMV's



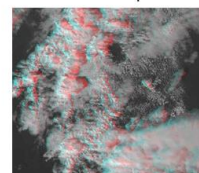
Analysing the interaction  
between low and upper  
levels of the atmosphere



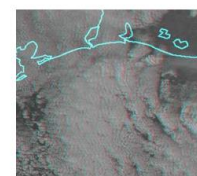
Analysing vertical motion of  
developing thunderstorms



Analysing atmospheric  
shear and trends in these



Better monitor low cloud  
below broken higher cloud



Detection of minor variations  
in height for oceanic cellular  
convection

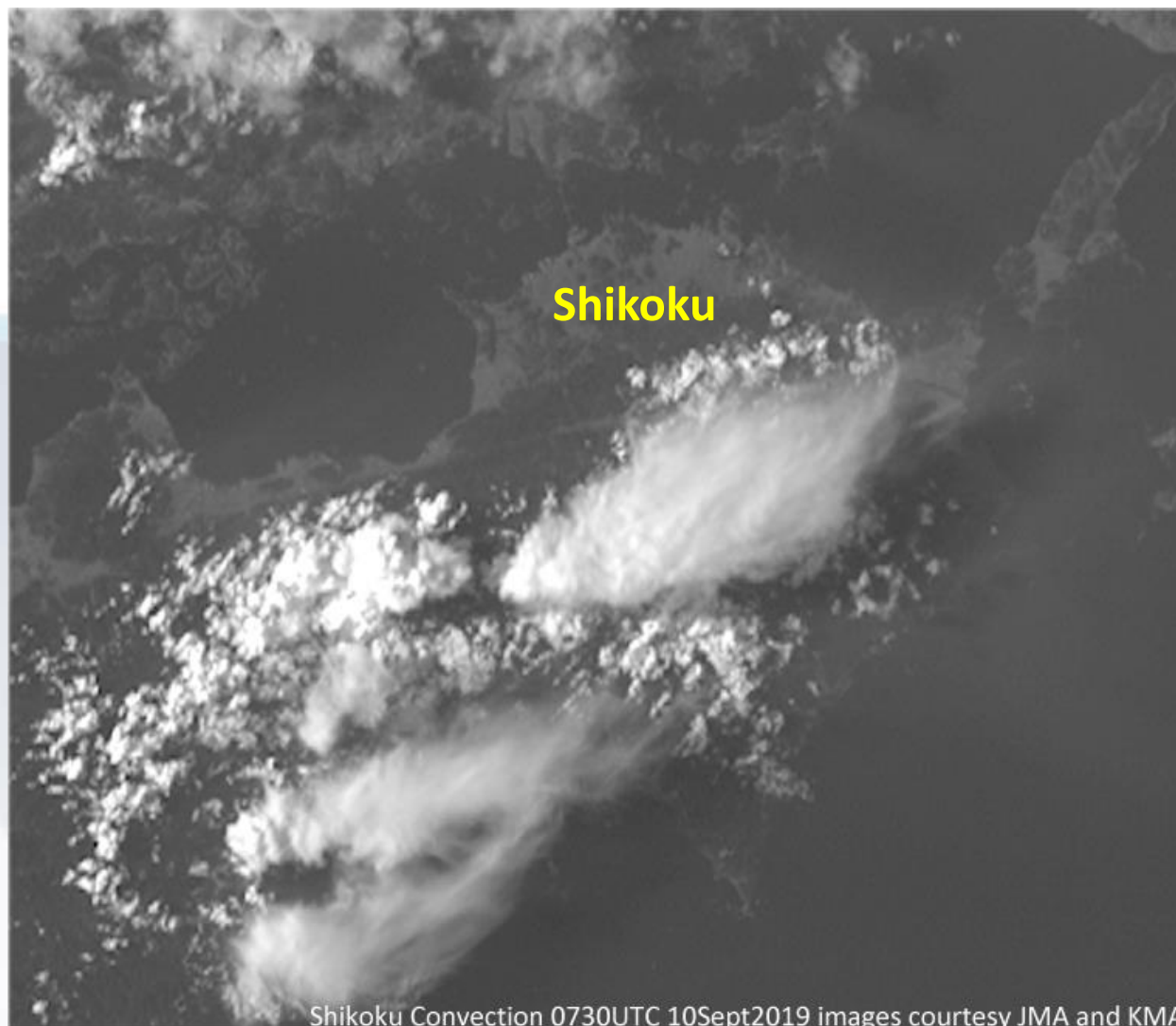
**...some slides not shown...**



## **Animation:** Demonstrating the stereo effect in GK-2A / H-8 data.

Shikoku thunderstorms, 0730UTC 10<sup>th</sup> September 2019 (2 frames per second Wiggle 3D animation)

Please view this  
animation  
carefully and  
desist if it feels  
uncomfortable

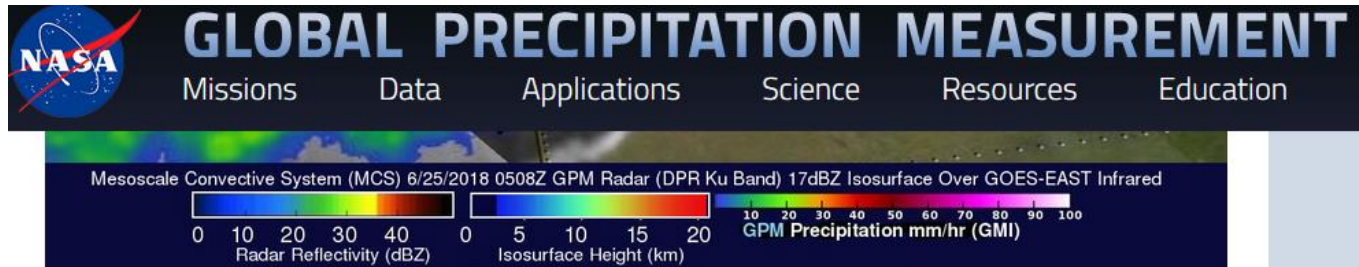


Shikoku Convection 0730UTC 10Sept2019 images courtesy JMA and KMA

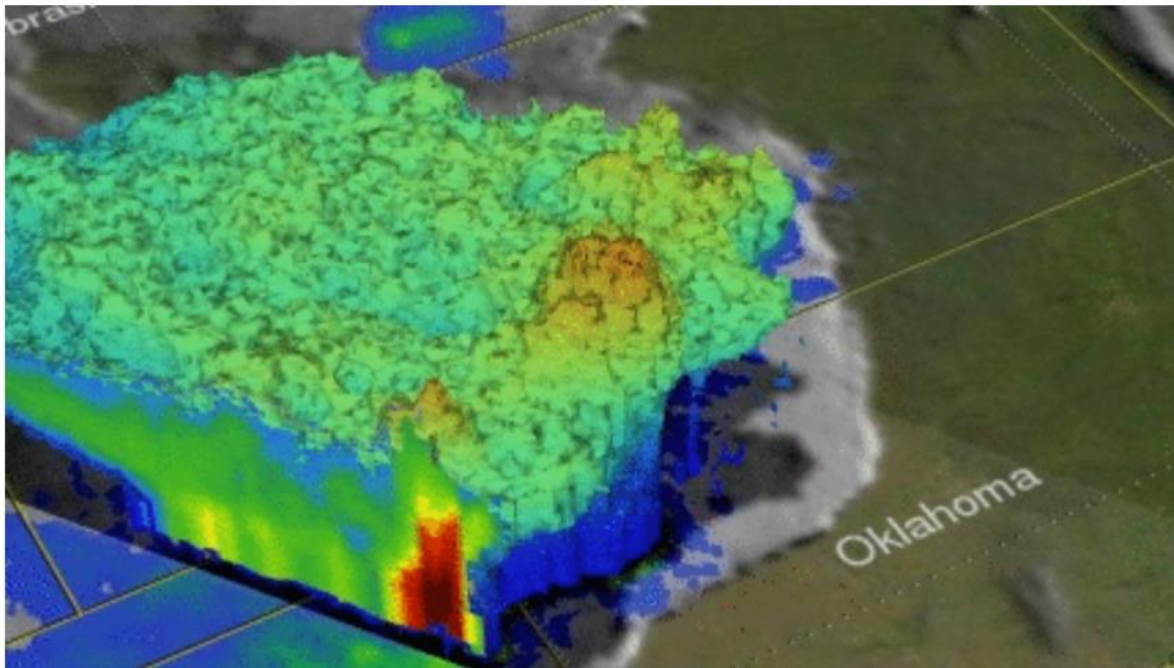
Please start the Power Point Slide Show to activate the animation

# Neat Visualisation of precipitation data in 3D

<https://gpm.nasa.gov/extreme-weather/oklahoma-mesoscale-convective-system-mcs-examined-gpm>



The GPM core observatory satellite's radar data (DPR ku Band) were used here to reveal the 3-D structure of precipitation within the storm system. GPM's radar revealed that that a few storm tops in this MCS were reaching heights of over 9.5 miles (15.4km).



Images and caption by Hal Pierce (SSAI/NASA GSFC)

# Explanation slide: Neat Visualisation of precipitation data in 3D

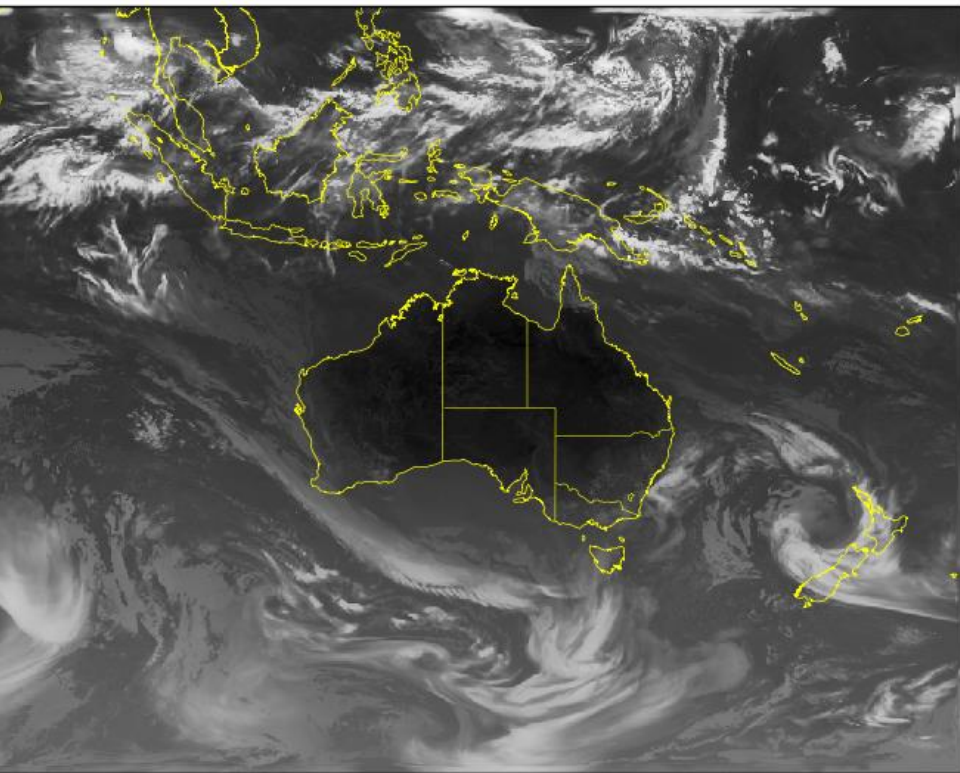
- This animation by Hal Pierce of (SSAI/NASA GSFC) is an example of how a meteorological feature might be examined in virtual reality. Note the 3D rendering of his thunderstorm complex. Note also how the angle of view changes during the video, simulating how it is possible to interrogate the data by "flying around" within virtual reality.
- Some feedback given by Marcial Garbanzo, TSO - WMO-CGMS Virtual Laboratory, as follows; "GPM 3D products to view precipitation datasets. Students love to use it as it bring the data to a different level. Instead of looking at 2D slices of data and trying to “connect it in the head”, they get to see the rain falling, drop size distribution and air currents (among others)".

**REFERENCE**

# Switching between "Real" and "Computer Generated"

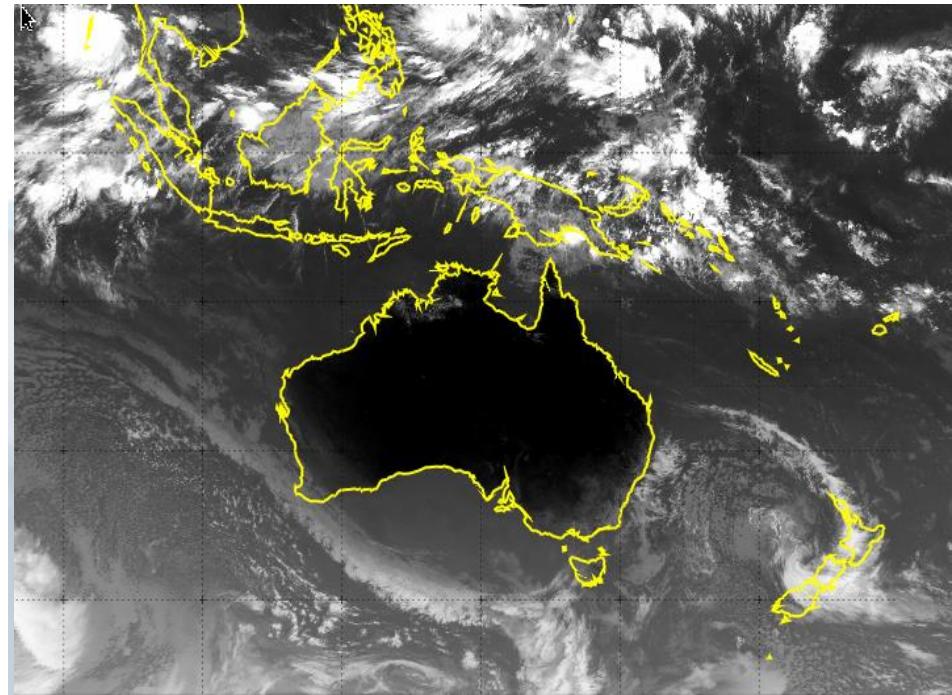
**From the first Regional Focus Group meeting, October 2013:** Synthetic satellite image vs MTSAT IR image

ACCE .110L70 12HRS FORC Valid 20131008 00UTC



Longitude

Synthetic IR satellite Image  
(ACCESS G model derived)  
Forecast for 00UTC 8<sup>th</sup> October



MTSAT image  
00UTC 8<sup>th</sup> October

# Explanation slide: Switching between "Real" and "Computer Generated"

- Here is a 2D example of this "integrated" data rendering as shown during our first Regional Focus Group meeting back in October 2013. This slide demonstrates how synthetically generated NWP model data can be made to look like observational data.
- The primary motivation for looking at synthetic imagery is that you can see many processes in an integrated way compared with looking at numerous model fields and integrating them mentally. This is similar to the feedback given by Marcial Garbanzo in the previous slide.
- Because the synthetic imagery is rendered to look like the satellite image therefore this permits easier comparison across the two data, either by a human or by an AI algorithm having pattern recognition.

**REFERENCE**

**...some slides not shown...**

